Project B-209

OVERLAID LUMBER

A Manufacturing Opportunity in Georgia

Prepared for

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Table of Contents

Page

Tables

Map

Foreword

Economic utilization of the state's vast timber resources through the development of a more diversified wood-based industry in Georgia has long been of prime interest to the Industrial Development Division's research staff. Evidence of this interest are the Division's 12 previous reports in the wood products field, seven of which were prepared as part of the continuing series of feasibility studies for the Department of Industry and Trade.

Sparked by recent reports of successful overlay techniques developed through extensive public and private research efforts, this study focuses on the potentials for upgrading the state's output of common-grade lumber through the establishment of facilities for producing overlaid lumber in Georgia. In the current series of product-industry analyses for the Department of Industry and Trade, this report is the first of three on wood product opportunities in the construction field.

Current developments in the manufacture and use of overlaid lumber will continue to be investigated after this report is released, and up-to-date information will be available upon request. Inquiries from individual companies interested in specifics relating to their particular needs and location requirements are invited and will be treated with complete confidence.

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Summary

Overlaying low-grade lumber with resin-treated paper or vulcanized fiber to improve its surface characteristics and salability is an important result of recent wood research. Wood siding used in the exterior-wall construction of new houses provides the major outlet for overlaid lumber. Other uses, such as house trim, signboards, boat hulls, stadium seats, shelving, and containers, are also reported.

Common-grade lumber accounts for 70% to 80% of southern pine lumber output in the state. The outlets of common-grade lumber have been in a depressed condition for many years. Overlaying provides not only a good opportunity for upgrading common-grade lumber, but also for adapting it to the new component concept in house construction. New wood siding made of overlaid lumber can be designed to be factory finished with a durable paint lasting 15 to 20 years. With this new product development, wood may hope to regain its position in the exterior siding market in the construction industry.

The price spread between low- and high-grade lumber is about $60.00 per thousand board feet in Georgia. This margin is large enough to permit a profitable overlaying operation. The cost of the currently available laminator plus auxiliary equipment is estimated at $40,000. Assuming an integrated operation with a planing mill or sawmill and operating on a one-shift basis with an annual output of 3.15 million board feet, the production cost per thousand board feet is estimated at $34.45 for overlaying and $85.00 for lumber. At a sale price of $145.00 per thousand board feet, net profit would be nearly $20,000, which is 50% of the fixed investment.

In a six-state area comprising Alabama, Florida, Georgia, North Carolina, South Carolina, and Tennessee, the market potential for overlaid lumber is estimated at 22.6 million square feet for lumber siding, 69.2 million square feet for all wood sidings, and 69.8 million square feet for other possible end uses in new house construction.

A profitable overlaying operation would require a mere 4.6% penetration of the market for all wood sidings or a 2.3% penetration of the combined markets for all wood sidings and other possible end uses in the Southeast. The lack of a single overlaying producer in this region makes this an excellent manufacturing opportunity for lumber producers in Georgia.

INTRODUCTION

Definition of the Product

Wood overlays are thin sheets of masking materials bonded to thicker wood-based stocks to improve the strength or surface characteristics of the wood. Masking materials may be resin-treated paper, vulcanized fiber, plastic film, or other materials. Wood-based stocks may be lumber, plywood, veneer, or other wood products.

Purpose and Scope of the Report

This report is concerned primarily with overlaid lumber because of its adaptability to Georgia conditions and the extensive research work being done on this product. Brief attention will also be given to overlaid plywood.

The main purpose of this report is to present the best information currently available on overlaid lumber in order to promote its production and application in the state. The more explicit aims of this report are as follows:

1. To give up-to-date information on the development of overlaid lumber and its importance to Georgia.
2. To describe briefly the technology of overlaid lumber.
3. To point out where further information can be obtained.
4. To provide a broad indication of the costs of equipment and production.
5. To estimate the market potential in the Southeast.

THE DEVELOPMENT OF OVERLAID LUMBER AND ITS ADAPTABILITY TO GEORGIA

Development and End Uses

In the past 20 years, the proportion of wood used in the housing market has been substantially reduced. Chief uses are wooden windows, roofing, exterior-wall siding, and sheathing. It has been reported that wood lost 70% of the siding market alone in the 1950's, due to the trend toward more maintenance-free houses. Since traditional wood siding requires regular repainting, aluminum, brick, stucco, and plastic have extensively invaded the wood market.

About 80% of the softwood lumber produced is used in residential construction. Since the housing industry is of such importance to lumber production, efforts by the lumber industry as well as by some public agencies have been concentrated in recent years in promoting more extensive use of wood as a construction material. The development of overlaid wood is within this concept.

There are two main kinds of overlaid wood -- overlaid plywood and overlaid lumber. Overlaid plywood has been produced commercially on the West Coast for more than 10 years, and production is reported to be expanding rapidly. Overlaid plywood is used for sheathing, roof-board panels, exterior siding, and signboards.

Overlaid lumber is a more recent development. It has been produced on a test-run basis by a few western lumber companies, and it has recently been test-sold in the midwestern markets. Overlaid lumber has end uses similar to those for overlaid plywood, but it is designed largely for exterior siding or for uses where a heavier exposed surface is required, such as stadium seats.

The objectives of manufacture of overlaid wood are:

1. to upgrade the lower grades of lumber;
2. to provide a surface improved in smoothness, paintability, and durability;
3. to provide a prefinished component rather than just a basic material; and
4. to increase the salability and profitability of lower-grade woods.

General advantages of overlaid lumber are improved paint performance, the reduction of surface checking and undesirable grain show-through, and the masking of unsightly blemishes in wood. It is waterproof and more stable than

regular lumber. It can be sawed, mortised, shaped, glued, and painted the same as conventional lumber, but it can not be planed to reduce its thickness.

The new trend in wood siding is toward a factory-finished product with preprimed coating. It is designed to be maintenance-free and to eliminate on-site labor for painting. With these new developments it is possible that the lumber industry may regain some of its lost market in wood siding, as well as in other house components.

The applications of overlaid wood are numerous. Perhaps house exterior siding offers the largest single outlet. Other uses, such as house trim, signboards, stadium seats, shelving, platforms, containers, boat hulls, and many other items, also are reported. The full potentials of overlaid lumber can only be determined when the production of this lumber is actually expanded to large-scale manufacturing.

Research Efforts

The U. S. Forest Products Laboratory in Madison, Wisconsin, started research work on overlaid woods as early as 1932. Numerous tests on overlay materials, wood species, and glue lines have been conducted.[1/] Some of the tests with southern pine and southern hardwood species have produced very satisfactory results. The marked differences between overlaid lumber and non-overlaid lumber in terms of paint retention characteristics, dimensional stability, paintability, and defects of checking, splitting, and cupping were evident. The Forest Products Laboratory is encouraging industry to engage in pilot-plant or semicommercial production in order to study the economics of overlaid lumber.

Several commercial firms and organizations have taken the lead in exploring the technique of overlays for commercial production. The Southern Pine Association has cooperated with National Starch and Chemical Corporation, National Vulcanized Fibre Company, Paterson Parchment Paper Company, and E. I. du Pont de Nemours & Company in developing data on the value of overlays on southern yellow pine. Currently National Starch and Chemical Corporation is developing a roll laminator for continuing high-speed operation. Crown Zellerbach

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1/ The details of these tests are given in various articles which are listed in the bibliography of this report.

Corporation has produced a resin fiber overlay used mainly on plywood. The Southern Pine Company in Diboll, Texas, has advanced experience in overlaid lumber, and it is reported that they may start actual production of overlaid lumber some time this year.[1/]

Overlaid plywood has been produced commercially on the West Coast for nearly a decade and has been sold in eastern markets for a long time. Weyerhaeuser Company, U. S. Plywood Corporation, and other western plywood plants which have engaged in this type of manufacturing have expanded production considerably in recent years. New wood siding made of overlaid plywood with factory finish and preprimed painting is expected to be important in the siding market.

The Importance of Overlaid Woods to Georgia

Since 1947, lumber output and the labor employed in its production have decreased by nearly one-half in Georgia. Moreover, many of the existing lumber mills in the state are struggling for survival because of the lack of market outlets for common-grade lumber, which generally accounts for 70% to 80% of the total lumber produced in the state. Finding new uses and outlets for common-grade lumber is essential for maintaining the present level of lumber production in the state or for regaining the long-lost wood siding market.

The result of research work by the U. S. Forest Products Laboratory and other organizations indicates the advisability of semicommercial production on overlaid lumber. In order to get a head start and to gain experience in this manufacturing, a manufacturer probably would undertake overlayment of lumber on a trial basis, integrated with other products.

Although there is no softwood plywood production in the state, the current development of southern pine plywood has greatly enhanced the opportunity of making overlaid plywood in the state as well. Overlaid plywood may have wider application than overlaid lumber because of its light weight and lower labor cost in construction.

1/ The addresses of these companies and their products related to overlaid woods are listed in Appendix 1.

TECHNICAL INFORMATION ON OVERLAID LUMBER

Paint Performance

The paint performance of overlaid lumber has been tested by many organizations. Perhaps the most notable study is one made by the U. S. Forest Products Laboratory.[1/] Four over-all conclusions from the study are quoted below:

1. The quality of machining or surfacing of wood, particularly on flat-grain surfaces, is a major factor in paint performance and early cracking of the paint film.
2. Commercial paints vary widely in their performance and durability on normal southern pine surfaces. This performance strongly indicates the need for the lumber industry to evaluate commercial paints and to screen out unsatisfactory products.
3. All paints perform far better on surfaces stabilized by resin-treated paper overlays than on unoverlaid surfaces.
4. The new synthetic polymers have great promise for durable paint on wood.

The advances of overlays and new synthetic polymers have greatly prolonged the service life of paint on wood siding. The recent joint promotional effort by U. S. Plywood and du Pont on PF-15 siding, an overlaid plywood with a guarantee of 15 years' freedom from painting, is a vivid indication of how new wood siding can perform. As a general rule, wood siding is cheaper per unit of exterior covering than most of its competing materials. Its use may mark the beginning of a long-delayed comeback of wood siding in the building-material market.

Glue Line

Most adhesives commonly used in the woodworking field are suitable for overlaying purposes. However, the consideration of economics, speed, and machines employed has limited the freedom of choice. Because of the probable use conditions for much overlaid lumber and the problems of trying to keep exterior- and interior-type bonding material separated, the U. S. Forest Products Laboratory recommends using only a durable exterior-type glue for overlaying. A

1/ H. O. Fleischer and J. M. Black, Research on Improving Paint Performance on Southern Pine, Forest Products Laboratory, Forest Service, U. S. Department of Agriculture, Madison, Wisconsin (a paper presented at the Research Committee Meeting of the Southern Pine Association, April 9, 1963, New Orleans, Louisiana).

room-temperature-setting, acid-catalyzed, phenol-resin glue has been used by the laboratory for exterior bonds.

Hot pressing technique currently is applied by most manufacturers in the production of overlaid plywood. Blood-type interior glue formerly was used for overlaid sheathing, but it was not successful in the market place. Crown Zellerbach Corporation has successfully applied exterior phenol-formaldehyde glue mix in its CreZon overlay material on veneer with hot press.

Lumber does not accommodate to hot pressing because of the warpage of lumber and bleeding-through of resins. Cold-setting glues have shown more promise on overlaid lumber, but it is difficult to obtain enough speed. National Starch and Chemical Corporation has developed a cold-setting, weather-resistant adhesive. Duro-Lok system, for overlaid lumber. The company is currently developing a high-speed roll laminator to accommodate its Duro-Lok system.

Overlay Materials

Two leading products in the field of overlay materials are CreZon overlay by Crown Zellerbach Corporation and Forbon overlay by National Vulcanized Fibre Company. CreZon overlay is a phenolic resin-treated sheet which can have a phenolic resin adhesive applied to one side. It is formed on a Fourdrinier paper machine from resin-treated pulp.

Forbon overlay is a vulcanized fiber which is a resin-free cellulosic plastic. It is made by immersing cotton waterleaf paper in a solution of zinc chloride, applying slight heat and pressure, and subsequently leaching the zinc chloride from the newly created product.

CreZon overlay is recommended for plywood, while Forbon overlay is recommended for lumber. Details of the characteristics of these two materials and the conditions for their application are given in Appendix 2.

In-Plant Finishing

The economic disadvantages of on-site exterior finishing can be illustrated by the following example:

> One mass builder, who works around the year on a short schedule of several weeks from slab to finished house, claimed that the painting of the exterior surfaces of the house could be done successfully during only about 3 months out of the 12 months of the year. This, of course, poses a terrific handicap to him in completing his responsibility to the home purchaser. It was stated that painting the average house by today's method with today's common paints takes as many painter man-hours as carpenter man-hours. He exclaimed, "It is so wasteful and expensive that it threatens not only to price paint itself out of the new house market, but also to price out all of the products that require frequent repainting, first among which would be wood siding and wood trim."1/

New wood siding made of overlaid lumber can be designed to be factory-finished with a durable paint lasting for 15 to 20 years. This new development is one result of the over-all efforts of the woodworking industry to establish a component construction system in the housing market in which prefinished parts are assembled at the site, thus holding on-site labor time to a minimum.

1/ H. O. Fleischer, "The Use of Wood in Tomorrow's House," Forest Products Journal, December 1960.

ECONOMICS OF OVERLAID LUMBER

Price Spreads of Low- and High-Grade Lumber

According to several industry sources, overlaid lumber can be sold at a higher price than clear-grade lumber of the same species, because of better surface characteristics and dimensional stability. Low-grade lumber is generally used in overlaying. The significance of the price spreads between low- and high-grade lumber is evident.

Southern yellow pine is the dominant local species used for construction purposes. There are four grades (C and Better, D, 2, and 3) of southern pine lumber produced in the state. Using 1-foot by 8-foot board with 3/4-inch thickness, kiln-dried, as standard, the current prices of these four grades are given in Table 1. The rates of output of the different grades in a standard sawmill are also given in the same table.

Table 1

STANDARD GRADES, PRICES, AND RATE OF OUTPUT OF SOUTHERN PINE LUMBER IN A SAWMILL, ATLANTA, GEORGIA, FEBRUARY 1964 (1' x 8' board, 3/4" thickness, kiln-dried)

Grade	Mill Price (per thousand board feet)	Rate of Output (per cent)
C and Better	$145	6
D	125	15
2	85	55
3 (Utility)	50	24

Number 2 accounts for about 55% of the total lumber output for average southern pine sawmills in this area, whereas the output of C and Better accounts for only 6%. The price spread between these two grades is $60 per thousand square feet, which should be a large enough margin for overlay costs and other expenses.

Estimated Production Costs

At this stage it may be too soon to make a reliable estimate of the production costs for overlaid lumber. Some data gathered at hand, nevertheless,

will give a broad indication of costs involved in such production. Assumption is made that the production is carried out as an integrated operation of a planing mill with no additional outlays necessary for building, land, and management.

Costs involved in the calculation are equipment, glue, labor, and overhead. Most costs given here were obtained through direct sources; however, some of them are based on estimates. These costs are presented in the following analysis:

Equipment. The currently available roll laminator used for overlaying lumber, which was developed by National Starch and Chemical Corporation, costs $20,000 per unit. The capacity of the machine is 30 lineal feet per minute, or 12,600 lineal feet per shift (assuming seven hours of production per shift). A new laminator is under development which would have a speed of 200 lineal feet per minute, or 84,000 lineal feet per shift. The cost of the new machine is unknown, but it is estimated at $50,000 here for calculation purposes.

Further assumptions in this illustration are that the laminator handles a 1-foot by 8-foot board without edge-jointing and that one lineal foot is equal to one square foot and one board foot, regardless of thickness.

Currently Available Machine:

Fixed investment

Laminator (1 unit)	$20,000
Automatic sheeting and auxiliaries	20,000
Total	$40,000

Depreciation charge

$\frac{\$40,000}{10 \text{ years}} = \$4,000$ per year

$\frac{\$4,000}{250 \text{ shifts}} = \$16$ per shift

$\frac{\$16}{12.6} = \$1.27$ per thousand square feet

New Machine under Development:

Fixed investment

Laminator (1 unit)	$ 50,000
Automatic sheeting and auxiliaries	50,000
Total	$100,000

Depreciation charge

$\frac{\$100,000}{10 \text{ years}}$ = \$10,000 per year

$\frac{\$10,000}{250 \text{ shifts}}$ = \$40 per shift

$\frac{\$40}{84}$ = \$0.48 per thousand square feet

Overlaying Material. Forbon vulcanized fiber is used here for lumber overlaying. Thickness of this material varies from 5 mils to 30 mils, depending upon end uses. For the purpose of overlaying lumber for use as wood siding, 5 mils and 10 mils are adequate. The costs are: 5 mils at \$0.019 per square foot and 10 mils at \$0.035 per square foot.

Glue. A durable exterior-type glue is used at a cost of \$4 per thousand square feet for overlaying on one side.

Labor. For the currently available laminator, it is assumed that four persons are required for the operation at \$64 per day (\$16 per person per 8-hour working day). For the new laminator, it is assumed that eight persons are required for production and handling of finished goods at \$128 per day, or \$16 per person.

Available Machine:

$\frac{\$64}{12.6}$ = \$5.08 per thousand square feet

New Machine under Development:

$\frac{\$128}{84}$ = \$1.52 per thousand square feet

Plant Overhead. Plant overhead is estimated at 120% of direct labor cost to cover various other costs, such as insurance, property tax, and maintenance.

Available Machine:

\$5.08 x 120% = \$6.10 per thousand square feet

New Machine under Development:

\$1.52 x 120% = \$1.82 per thousand square feet

The major cost outlays for lumber overlaying are given in Table 2 on a per thousand square feet basis. Two separate estimates are included -- one for currently available machinery and one for the new machine under development.

Table 2

ESTIMATED PRODUCTION COSTS PER THOUSAND SQUARE FEET
OF LUMBER OVERLAYING ON AVAILABLE MACHINE
AND DEVELOPING MACHINE
(Based on one-shift operation, 250 days a year)

Item	Available Machine (3,150,000 bd. ft. a year)	New Machine Under Development (21,000,000 bd. ft. a year)
Vulcanized fiber	$19.00	$19.00
Glue	4.00	4.00
Labor	5.08	1.52
Equipment depreciation	1.27	.48
Plant overhead	6.10	1.82
Total	$35.45	$26.82

The production cost of lumber overlaying is estimated at $35.45 per thousand square feet for the currently available laminator and at $26.82 per thousand square feet for the new laminator under development. The difference in production costs is $8.63 per thousand square feet. However, the price spread between Number 2 and C and Better southern pine lumber of $60 per thousand board feet will give a large enough margin to absorb operating costs of either machine.

Suppose overlaid lumber, using Number 2 lumber as overlaying stock, is sold at the same price ($145 per thousand board feet) as C and Better southern pine lumber. The estimated production costs and profits, based on one-shift operation and 250 shifts a year, are given in Table 3 for the currently available machine and in Table 4 for the new machine under development.

The speed of output of a given machine has a great influence on over-all production costs and, consequently, on profits, as indicated in Tables 3 and 4. An annual output of 3 million board feet of overlaid lumber probably can be integrated into a planing mill without much trouble.

When the production capacity is increased to 21 million board feet a year, it is more logical to have an independent operation. This would require additional outlays for land, building, auxiliary tools, trucks, and management.

Table 3

ESTIMATED PRODUCTION COSTS AND PROFITS ON LUMBER OVERLAYING ON THE CURRENTLY AVAILABLE LAMINATOR
(Based on one shift per day and 3,150,000 board feet a year)

	Per Thousand Board Feet	Annual Totals
Sales	$145.00	$456,750.00
Production Costs		
Lumber	$ 85.00	$267,750.00
Vulcanized fiber	19.00	59,850.00
Glue	4.00	12,600.00
Labor	5.08	16,002.00
Equipment depreciation	1.27	4,000.50
Plant overhead	6.10	19,215.00
Total	$120.45	$379,417.50
Variable Profit		77,332.50
Less: Sales expenses (7% of total sales)		31,972.50
Net Profit before Taxes		$ 45,360.00
Less: Taxes (52% Federal and 4% State)		25,401.16
Net Profit		$ 19,958.84
Return on fixed investment of $40,000		50%
Payout period to cover fixed investment		2 years

The new trend is to make wood siding of overlaid plywood or lumber, factory finished. This requires additional outlays on machinery, labor, and paint coating. The current wholesale price in Atlanta of PF-15 siding, an in-plant finished overlaid plywood, is $220 per thousand square feet. Worth noting is the fact that the price spread between overlaid lumber and factory-finished wood siding is even greater than the spread between low- and high-grade lumber.

Table 4

ESTIMATED PRODUCTION COSTS AND PROFITS ON LUMBER OVERLAYING ON THE NEW LAMINATOR UNDER DEVELOPMENT
(Based on one shift per day and 21,000,000 board feet a year)

	Per Thousand Board Feet	Annual Totals
Sales	$145.00	$3,045,000.00
Production Costs		
Lumber	$ 85.00	$1,785,000.00
Vulcanized fiber	19.00	399,000.00
Glue	4.00	84,000.00
Labor	1.52	31,920.00
Equipment depreciation	.48	10,080.00
Plant overhead	1.82	38,220.00
Total	$111.82	$2,348,220.00
Variable Profit		696,780.00
Less: Sales expenses (7% of total sales)		213,150.00
Net Profit before Taxes		$ 483,630.00
Less: Taxes (52% Federal and 4% State)		270,832.80
Net Profit		$ 212,797.20
Return on fixed investment of $100,000		213%
Payout period to cover fixed investment		6 months

Trends in Materials Used for House Exteriors

Since wood siding is the major outlet for overlaid lumber, the trends in exterior-wall siding should be scrutinized. Wood siding was used in over 40% of all new houses built in the United States in the 1940's, but it declined to 24% in 1962. However, since 1956 wood siding has held its own in the house exterior market, maintaining a level of 23% to 24% of all materials used. Non-wood sidings which have invaded the traditional wood market are brick, aluminum, and plastic. The percentage of masonry used has not expanded too much since 1940. The details of exterior-wall construction of new houses since 1940 are given in Table 5.

Table 5

U. S. TRENDS IN EXTERIOR-WALL CONSTRUCTION IN NEW HOUSES, 1940-1962

Exterior-Wall Construction	Per Cent of All Materials Used						
	1940	1950	1954	1955	1956	1959	1962
Masonry	11	11	13	20	16	18	12
Wood frame	89	89	82	77	83	82	88
Wood siding	43	43	31	29	24	25	24
Non-wood siding	46	46	46	40	52	46	56
Mixed siding			5	8	7	11	8
Unknown			5	3	1		

Sources: New Housing and Its Material, 1940-1956, Bureau of Labor Statistics, U. S. Department of Labor

Reports of Forest Products Marketing Branch, Division of Forest Economics, U. S. Department of Agriculture, 1959-1962

There are four major kinds of wood siding available in the market -- lumber, plywood, fiberboard, and shingle (or shake). The relative importance of lumber, which used to dominate the wood siding market, has been slipping, and the markets for plywood and fiberboard sidings have been expanding in recent years. In addition, the proportions of different wood sidings used in new housing units vary considerably among geographical regions, because climatic conditions and the supply of building materials in different regions influence

the use of materials. The amounts of different wood sidings used in FHA-inspected, single-family houses in various geographic regions, as percentages of all materials used, are given in Table 6.

Table 6

PERCENTAGES OF DIFFERENT WOOD SIDINGS USED IN FHA-INSPECTED, SINGLE-FAMILY HOUSES, BY GEOGRAPHIC REGION, 1959 AND 1962

Region	Lumber		Plywood		Fiberboard		Shingle		Total	
	1959	1962	1959	1962	1959	1962	1959	1962	1959	1962
All regions	10	8	2	3	5	8	8	5	25	24
Northwest	28	36	9	8	11	10	8	7	56	61
Southwest	1	*	2	4	1	3	2	1	6	8
Lake States	27	7	1	2	7	13	2	3	37	25
Central States	16	12	4	3	17	17	12	5	49	37
South Central States	15	9	1	3	1	4	9	1	26	17
North Atlantic	4	3	1	1	2	6	19	15	26	25
South Atlantic	9	4	*	3	5	6	2	2	16	15
Florida	1	1	1	1	1	1	*	*	3	3

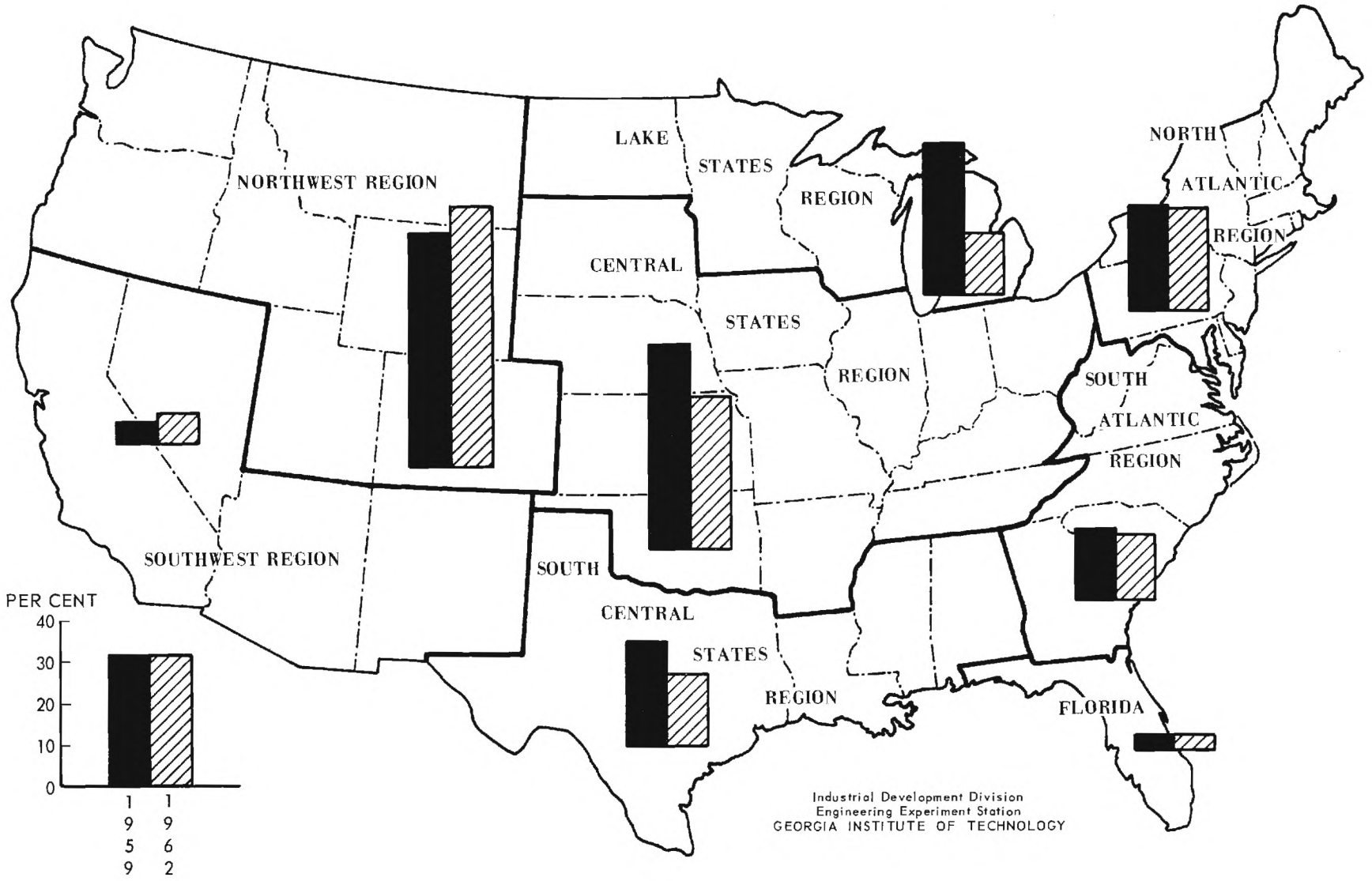
*Less than 0.5%

Source: Forest Products Marketing Branch, Division of Forest Economics, U. S. Department of Agriculture

Between 1959 and 1962, the use of lumber siding declined in all regions except the Northwest. In contrast, plywood and fiberboard expanded somewhat in the same period. Shingle or shake registered a sharp drop in many regions. Considering all wood sidings as a whole, the Northwest increased from 56% in 1959 to 61% in 1962, while most other regions declined in different degrees. The South Atlantic, Central, and South Central states, which are the regions within reach of Georgia lumber, registered 15%, 37%, and 17%, respectively, in 1962. In the United States as a whole, the use of exterior wood siding declined very little from 1959 to 1962.

Map 1 graphically illustrates the above trends in wood-siding use for new single-family houses in different geographic regions.

MAP 1
PER CENT OF WOOD SIDINGS USED IN FHA-INSPECTED, SINGLE-FAMILY HOUSES,
BY GEOGRAPHIC REGION, 1959 AND 1962



Market Potential for Overlaid Lumber in the Southeast

Although overlaid lumber can be used in many places where a smooth, paintable surface is required, this report deals with only its major potential outlet -- the housing market. At the present time, the use of overlaid lumber in exterior-wall construction for individual dwelling units seems most promising. Other uses in housing construction, such as soffits, carport ceilings and boxing, porch boxing, door frames, and wood louvers, also are feasible. According to an industry source, overlaid lumber can be substituted for about 5% of lumber used in a frame house, with a better result.

A Georgia manufacturer of overlaid lumber would sell primarily to customers in six southeastern states -- Alabama, Florida, Georgia, North Carolina, South Carolina, and Tennessee. In order to assess the potentials of overlaid lumber in the area's housing market, estimates are made of the use in 1962 of lumber siding (Table 7), all wood sidings (Table 8), and all lumber for wood framing (Table 9) in single-family house construction. Data on percentages of lumber siding and all wood sidings used are not available by state, so figures for the region in which each state falls are used in Tables 7 and 8. Although the estimate for Tennessee may tend to be on the high side and that for North Carolina on the low side, these estimates tend to reach a balance in the six-state total figure. The average exterior-wall area of a medium-sized frame house is from 2,000 to 3,000 square feet. A median of 2,500 square feet is used for estimating purposes.

Lumber siding used in the six-state area in 1962 is estimated at 22.6 million square feet in Table 7. Tennessee and Alabama were the largest users in the region, followed by Georgia and North Carolina. Although Florida had the greatest number of housing starts in the region, the use of lumber siding was the lowest in percentage. Masonry and concrete blocks are the dominant types of materials used for exterior walls in Florida.

All wood sidings used in the six-state region in 1962 are estimated to total 69.2 million square feet. The estimates vary from 20 million square feet in Tennessee to 5 million square feet in Florida. The details are given in Table 8.

Although plywood and fiberboard sidings have gained over lumber siding in recent years, lumber siding still accounts for about 50% of all wood sidings

used in this region, according to several large lumber and plywood distributors in Atlanta. If this is true, lumber siding used in the six states in 1962 would have been 34.8 million square feet instead of the 22.6 million square feet estimated in Table 7.

Besides wood exterior sidings, other possible end uses of overlaid lumber are estimated at nearly 70 million square feet in the six-state area in 1962. The details are given in Table 9.

Table 7

ESTIMATE OF LUMBER SIDING USED IN SINGLE-FAMILY HOUSES IN SIX SOUTHEASTERN STATES, 1962

State	Private Nonfarm Housing Starts 1/	Per Cent of Single-Family Houses Using Lumber Siding 2/	Number of Houses with Lumber Siding	Av. Est. Wall Area of a Single-Family House (sq. ft.)	Estimated Lumber Siding Used (sq. ft.)
Alabama	23,300	9	2,097	2,500	5,242,500
Florida	70,200	1	702	2,500	1,755,000
Georgia	39,800	4	1,592	2,500	3,980,000
North Carolina	35,100	4	1,404	2,500	3,510,000
South Carolina	14,700	4	588	2,500	1,470,000
Tennessee	22,100	12	2,652	2,500	6,630,000
Total					22,587,500

Sources:

1/ Housing Starts for States, 1959-1962, National Association of Home Builders, Special Report 63-3, June 4, 1963.

2/ Table 6.

Table 8

ESTIMATE OF ALL WOOD SIDINGS USED IN SINGLE-FAMILY HOUSES IN SIX SOUTHEASTERN STATES, 1962

State	Private Nonfarm Housing Starts[1]	Per Cent of Single-Family Houses Using All Wood Sidings[2]	Number of Houses with Wood Siding	Av. Est. Wall Area of a Single-Fam. House (sq. ft.)	Estimated All Wood Sidings Used (sq. ft.)
Alabama	23,300	17	3,961	2,500	9,902,500
Florida	70,200	3	2,106	2,500	5,265,000
Georgia	39,800	15	5,970	2,500	14,925,000
North Carolina	35,100	15	5,265	2,500	13,162,500
South Carolina	14,700	15	2,205	2,500	5,512,500
Tennessee	22,100	37	8,177	2,500	20,442,500
Total					69,210,000

Sources:

1/ Housing Starts for States, 1959-1962, National Association of Home Builders, Special Report 63-3, June 4, 1963.

2/ Table 6.

Table 9

ESTIMATE OF OTHER POSSIBLE END USES OF OVERLAID LUMBER IN WOOD FRAME HOUSES IN SIX SOUTHEASTERN STATES, 1962

State	Private Nonfarm Housing Starts[1/]	Per Cent of Wood Frame Houses[2/]	Number of Wood Frame Houses	Average Lumber Used in Wood Frame House (sq. ft.)	Total Lumber Used in Frame Houses (thousand sq. ft.)	Estimated Possible Uses of Overlays* (sq. ft.)
Alabama	23,300	100	23,300	10,000	233,000	11,650,000
Florida	70,200	8	5,600	10,000	56,000	2,800,000
Georgia	39,800	99	39,400	10,000	394,000	19,700,000
North Carolina	35,100	99	34,700	10,000	347,000	17,350,000
South Carolina	14,700	99	14,600	10,000	146,000	7,300,000
Tennessee	22,100	100	22,100	10,000	221,000	11,050,000
Total						69,850,000

* Based on an estimate that overlaid lumber can be substituted for about 5% of lumber used in a frame house.

Sources:

1/ Housing Starts for States, 1959-1962, National Association of Home Builders, Special Report 63-3, June 4, 1963.

2/ Forest Products Marketing Branch, Division of Forest Economics, U. S. Department of Agriculture.

CONCLUSION

Overlaying lumber to improve its surface characteristics and dimensional stability is technically feasible at the present stage. Overlaid lumber can be made into factory-finished wood siding with a new improved paint coating which will last 15 years or more. These new developments should stimulate increased use of lumber siding in exterior-wall construction in new houses.

Common-grade lumber accounts for 70% to 80% of southern pine lumber output in Georgia, which has had a depressed market for many years. The technique of overlaying low-grade lumber to improve its paint-holding characteristics and salability is a significant recent development in wood research which may help wood siding to regain its position in the competitive siding market.

Currently there is not a single overlaid lumber producer in the Southeast. Since many lumber mills in the state are experiencing difficulty in finding adequate market outlets, the opportunity offered in the field of overlaying should not be overlooked.

The price spread between low- and high-grade lumber is about $60 per thousand board feet in the state, a margin large enough to cover overlaying costs even with the presently available roll-laminating technique. Further development of a high-speed laminator should result in a wider profit margin.

The wood siding market provides a major outlet for overlaid lumber. The lumber siding used in new houses in 1962 is estimated at 22.6 million square feet and all wood sidings is estimated at 69.2 million square feet in the six southeastern states. In addition, it is calculated, based on an estimate of lumber used in wood frame houses, that there are nearly 70 million square feet of possible other end uses in new house construction.

An operation using the currently available laminator with annual output of 3.15 million board feet would need to penetrate only about 4.6% of the total wood siding market or 14% of the lumber siding market in the six-state area in order to attain a 50% annual return on fixed investment of $40,000. If other possible end uses are included in the picture, it would need to penetrate only about 2.3% of the possible market (all wood sidings and other possible end uses).

APPENDICES

Appendix 1

PARTIAL LIST OF COMPANIES AND PUBLIC AGENCIES ENGAGED IN OVERLAYING RESEARCH WORK

Organization and Address	Type of Research Work
Crown Zellerbach Corporation 1100 Public Service Building Portland 4, Oregon	Resin-treated-paper overlaying on wood
C. A. Litzler Company 235-9 Brookpark Road Cleveland 9, Ohio	Glue and laminating machine
National Starch and Chemical Corporation 1700 West Front Street Plainfield, New Jersey	Glue and roll-laminating machine
National Vulcanized Fibre Company Wilmington, Delaware	Vulcanized-fiber overlaying on wood
Southern Pine Company Diboll, Texas	Roll-laminating technique on wood
Weyerhaeuser Company Tacoma Building Tacoma 1, Washington	Overlaid plywood and lumber
Agricultural Experiment Station University of Georgia Athens, Georgia	Technical information about overlaid lumber
Forest Products Laboratory U. S. Forest Service Madison 5, Wisconsin	Wood-overlaying technology
Georgia Forestry Commission Box 1077 Macon, Georgia	Technical information about overlaid lumber
Southeastern Forest Experiment Station U. S. Forest Service Post Office Building Asheville, North Carolina	Technical information about overlaid lumber
Southern Pine Association National Bank of Commerce Building P. O. Box 52468 New Orleans 50, Louisiana	Technical information about overlaid southern pine lumber

Appendix 2

TECHNICAL INFORMATION ON DURO-LOK GLUE,
PAINT FORMULATION ON EXTERIOR WOOD FINISH,
VULCANIZED FIBER, AND CREZON OVERLAY

STRUCTURAL PRODUCTS DIVISION

BULLETIN No. NEW YORK 2743
(supersedes 1452)

National STARCH and CHEMICAL CORPORATION

Technical Service Bulletin

DURO-LOK® 150 (42-2150)

For the first time, a cold-setting weather resistant adhesive is available for the Kwik Klamp process. It is recommended for plastic foams, hardboard, softboard, cement asbestos board, wood and other cellulosic materials. At least one surface must be absorbent to water. Modifications are available which will give equivalent performance on some metals.

TYPE OF PRODUCT: Thermosetting emulsion

TYPICAL PHYSICAL PROPERTIES:

Solids	47%
Pounds/Gallon	9.2
Freeze-Thaw Stab.	Fair.
Thinner	Water (not over 5%)
pH	5.0
Viscosity	4500 cps before addition of catalyst.

CATALYST:*

Use 5% by weight of Catalyst 42-2300 on weight of Duro-Lok as received. Thorough mixing results in a green pastel color which makes adhesive application visible. When product end use makes this green color undesirable, 5% by weight of Catalyst 42-2301 may be substituted.

With Catalyst 42-2301, the glue line is normally a translucent, light straw color, but varies somewhat with wood species. Some discoloration on various species of pine has been observed after aging. Therefore, if glue line color is important, the wood species involved in any particular operation should be checked for staining.

Since 42-2301 cross links the adhesive at a slower rate than 42-2300, it should not be used at temperatures below 65°F., or where finished product will be exposed to water before final cure is obtained.

*NOTE: Duro-Lok adhesives have been used in production with a wide variety of the more common wood species. To date, aging data has shown excellent performance in both actual service and accelerated testing. It is suggested, however, that Duro-Lok be evaluated under the production and service conditions under which it is expected to perform.

CATALYST (cont'd.)

With Duro-Lok adhesives, the correct amount of catalyst should be accurately measured and thoroughly mixed. One fluid ounce of catalyst per gallon of Duro-Lok is equivalent to 1% by weight of 42-2300 or 42-2301.

WORKING LIFE:

24 hours at 72°F., 2½ hours at 100°F.

STORAGE:

Duro-Lok should be stored below 72°F. Maximum useful life will be obtained when stored at 40-60°F. During storage, viscosity will slowly increase. The adhesive is satisfactory for use if it can be stirred and if it machines smoothly. The Duro-Lok containers are dated so you can maintain careful inventory control.

OPERATING INSTRUCTIONS:

Application	Brush, roller, glue spreader - generally any method except spray. One-side application normally OK.
Coverage	Smooth surfaces 25-35 pounds-M ft.^{2} single glue lines. Screenbacks, foams or absorbent materials 40-55 pounds.
Temperature	Over 65°F. at glue lines, 75-85°F. preferred.
Open Time	5 minutes } These will
Closed Assembly	30 minutes } vary with
Press Time	30 minutes } substrate.
Machining Time	1 hour after press cycle.
Strength Build-Up	Wood/Wood - over 400 psi immediately from press, over 500 psi one hour after press.
Clean-Up	Water 80-90°F. before fully dry. Hot water will soften film sufficiently to scrape off during next 24 hours.

CURE TIME:

Boiling water resistance is developed very rapidly and meets specifications in 24 hours at 70°F. Cold water resistance is developed approximately to 50% of final strength in 24 hours at 70°F., but is still increasing after 30 days. Complete cure can be achieved in approximately 3 minutes at 300°F.

CAUTION: All water resistant adhesives can cause dermatitis to people with sensitive skins. Standard precautions of cleanliness and ventilation should be observed. The catalyst is acidic and should be flushed off with water. Do not allow to dry on skin.

Performance of Duro-Lok 150 with Catalyst 42-2300:

	Strength	Wood Failure	Time After Bonding
Block Shear (ASTM-D-905-49)	3600 psi	30%	4 days
Tensile Shear (ASTM-D-1002-49) Birch Lap Joint	1000 psi	100%	4 days
Tensile Shear (ASTM-D-906-49) Birch Plywood and (CS-35-60)	430 psi	100%	4 days
Tensile Shear Static			
Birch Lap Joint - 180°F.	100 psi	168 hours	7 days
- 70°F.	1000 psi	168 hours	7 days

In both laboratory and production tests, this adhesive, when used as specified in our technical data sheets, has repeatedly met the requirements of each of the following specifications:

Water Resistance:

ASTM-D-1037 Accelerated Aging Test — All cellulosic materials tested to date have shown deterioration greater than the adhesive.

	Strength	Wood Failure	Time After Bonding
CS-35-61 Type I Birch Plywood	400 psi	80%	24 hours
CS-35-61 Type II Birch Plywood	Pass- 15 cycles		7 days
CS-45-60 Interior Douglas Fir Plywood	Pass- 3 cycles		7 days
CS-45-60 Exterior Douglas Fir Plywood	Cold Soak	100%	7 days
	Boil Test	100%	7 days

	Strength	Wood Failure	Time After Bonding
48-Hour Cold Water Soak Birch Plywood (MMM-A-175 Method 2031, Procedure 4-1)	185 psi	0%	1 day
	305 psi	0%	7 days
	380 psi	60%	30 days
CS-171-58 Hardwood Veneered Doors:	Passed Type I and Type II requirements on both hollow and solid core doors.		

National RESINS

PAINT FORMULATIONS

One of a series of new paint formulas developed by NATIONAL paint research chemists for paint chemists everywhere

EXTERIOR WOOD FINISH R 286-83-A
(Based on National's Resyn® 25-1251)

Increasing interest in factory or in-plant finishing of exterior siding has focused attention on the need for coating systems that combine proven exterior durability with the economics and processing characteristics necessary for this use.

Polyvinyl acetate copolymer latexes show good promise in satisfying this need. As far back as 1954, studies were initiated with paint formulas based on the first vinyl copolymer vehicle introduced to the market, Resyn 25-1251.

One such formula E404-R4 was included in a series of paints tested in an independent study conducted simultaneously on fences located in Mississippi and Wisconsin. Using yellow pine drop siding with and without paper overlay, the weathering characteristics of these paints were carefully checked for seven years. After this extensive exposure, the results obtained with the 25-1251 based formula were classified as impressively good and it was rated one of the best.

Another study conducted by National Starch and Chemical Corporation Paint Chemists in New Jersey, produced similar results with average erosion ratings of "9" after eight years exposure.

Formula R 286-83-A (attached) is a modern version of the original E404-R4 used in these studies. Still based on 25-1251, it has been further improved to make it more suitable for in-plant production and application. Solids are higher to increase the amount of build per coat and thickener has been decreased to lower the water solubles.

Application of the formula can be made by conventional spray, curtain coater or roller coater. It is suggested that R 286-83-A be applied self primed on paper overlaid wood and top coated over oil or alkyd primed wood without the overlay.

Further details, data on exterior exposures and pictorial evidence can be obtained by writing Resin Division, National Starch and Chemical Corporation, 750 Third Ave., New York 17, N. Y.

NATIONAL STARCH and CHEMICAL CORPORATION
750 Third Avenue, New York 17 • 3641 So. Washtenaw Avenue, Chicago 32 • 735 Battery Street, San Francisco 11
And all principal cities in the United States, Canada, England and Mexico

National RESINS

PAINT FORMULATIONS

One of a series of new paint formulas developed by NATIONAL paint research chemists for paint chemists everywhere

SUGGESTED EXTERIOR WOOD FINISH
WHITE & LIGHT TINT BASE
R 286-83-A

	LBS.	GALS.
CHARGE INTO MIXER UNDER AGITATION:		
Water	145.0	17.5
Potassium Tripolyphosphate	0.5	-
Tamol 731 (25% N.V.)	3.0	0.3
Advawet 33	2.5	0.3
Methocel 4000 cps. (2% Solution)	60.0	7.1
Colloid 677	1.0	0.1
Titanox RA-50	265.0	7.6
Nytal 300	120.0	5.1
Mineralite 3X	30.0	1.3
DISPERSE IN HIGH SPEED MILL, THEN ADD SLOWLY WITH AGITATION:		
Water	75.0	9.0
Resyn 1251	415.0	45.5
Water	30.0	3.6
Hexylene Glycol) premix	15.0	2.0
Cosan PMA-30)	5.0	0.6
	1167.0	100.0

MANUFACTURING INSTRUCTIONS:

Charge components in the above sequence, continue mixing until a smooth, homogeneous paste is obtained.

The amount of foam inhibitor will depend upon the particular manufacturing equipment employed. Use as little as possible to avoid "crawling" or "fish eyes."

Add the hexylene glycol slowly with sufficient agitation.

PHYSICAL CHARACTERISTICS:

PVC 37.7%	Vehicle 64.0%
Lbs./Gal. 11.7	Veh. Non Vol. 30.6
Viscosity. . . . . 75-85 KU	Veh. Vol. 69.4
Pigment. 36.0	
Total Solids. 56.0%	

NATIONAL STARCH and CHEMICAL CORPORATION
750 Third Avenue, New York 17 • 3641 So. Washtenaw Avenue, Chicago 32 • 735 Battery Street, San Francisco 11
And all principal cities in the United States, Canada, England and Mexico

NATONAL VULCANIZED FIBRE COMPANY

TYPICAL PHYSICAL CHARACTERISTICS OF VULCANIZED FIBRE

	FORBON		Med. Density Paper Overlay	Parchment
Thickness	.005"	.010"	.018"	.005"
Sq. Ft./Lb.	35	16	16	40
Tensile Strength (Dry) Lbs./in. width - Grain Direction	100	190	85	75
- Cross Grain Direction	40	95	50	30
Tensile Strength (Wet) Lbs./in. width - Grain Direction	40	100	40	30
- Cross Grain Direction	25	60	25	20
Tear Strength (Grms.) Grain Direction	120	295	100	75
Cross Grain Direction	125	300	120	75
Burst Strength Mullen, psi	115	210	65	70
Bending, 180° Min. Dia. Mandrel Grain Direction	.025"	.025"	.11"	.025"
Cross Grain Direction	.040"	.040"	.22"	.040"
Abrasion Resistance Loss of Thickness	.0007"	.0007"	.0025"	.0009"

(Typed verbatim from National Vulcanized Fibre Company release.)

December 1, 1963

CROWN ZELLERBACH CORPORATION

CREZON OVERLAY

DESCRIPTION

This product is a phenolic resin treated sheet which can have a phenolic resin adhesive applied to one side. It is formed on a fourdrinier paper machine from resin treated pulp. The process of treating the pulp with resin before forming it into a sheet is called "beater loading," and is contrasted to "impregnating," which implies that the sheet was first formed and then treated with resin.

PHYSICAL DATA

Average paper test data are listed below. Some values are given both for the sheet as shipped by Crown Zellerbach (uncured), and after press curing at 285°F and 200 PSI for six minutes (cured).

Fiber finish.....Not more than 83% sulphite pulp by weight

Resin.....Not less than 17% by weight-phenol formaldehyde type

Resin treating method.....Beater loading

Basis weight.....B-185 without glueline, 58.7-64.7 lbs. per MSF.
B-210 with glueline, 67.0-73.0 lbs. per MSF.

	B-185 (without glueline)		B-210 (with glueline)	
	Uncured	Cured	Uncured	Cured
Tensile Strength (lbs./in.)				
Machine Direction	124	136	101.6	106.8
Cross Machine Direction	70	74	54.8	59.6
Caliper	.015-.017	.012-.014	.016-.018	.013-.015
Moisture	5 - 10%		3 - 5%	
% Strength Retained when wet	54	64	36	70
Tear (Gram/meter)				
Machine Direction	217		259	
Cross Machine Direction	319		306	

The pH specification for CreZon at time of manufacture is 4.5. The pH of cured CreZon is usually in the 4.5 to 6.0 range, somewhat dependent on the type of glueline used.

CreZon is manufactured under U. S. Patent No. 2,804,418, issued August 27, 1957 to G. D. King and assigned to Crown Zellerbach Corporation.

GLUELINE

The glueline is a phenol-formaldehyde resin adhesive. CreZon is intended primarily for exterior installations, as the glueline itself gives performance equal or superior to that specified for exterior plywood in Commercial Standard CS 45-60 for Douglas Fir Plywood.

DISCUSSION

CreZon Overlay is a phenolic resin-treated paper manufactured by the beater loading process. This process yields a structure which is particularly suited to overcoming the major problems connected with overlaying plywood specifically, and also other wood products.

Beater loading means that the resin binder for the fibers is added to the pulp before it is formed into a sheet. Resin added in this manner tends to be deposited on the fibers in minute globules rather than uniformly coating them. In the paper-making process which follows, the fibers are felted together.

The resin globules tend to catch and hold any free fiber which they touch, so that practically all fiber junctions occur at points where resin has been deposited. This gives an overlay with a microscopic structure similar to a woven wire screen with welded joints.

The performance advantages which this type of structure gives an overlay are:

1. Very high "wet strength" - because the fiber junctions are essentially "welded" they are impervious to water.

2. High resistance to the passage of liquid water -- the holes in the mesh structure are so small that the high surface tension of water practically prevents its passage.

3. Oils, such as the drying oils in paints, are readily absorbed, giving the paint film a good anchor to the surface. Oils have relatively low surface tensions, so their passage is not retarded by CreZon's structure. The wire side of the CreZon sheet is calender sized to improve paintability.

4. CreZon does not have a hard skin, but is uniform in its composition through its thickness. Since the resin is precipitated on the fibers before the paper-making process, all fibers are essentially identical with respect to resin concentration distribution.

5. Because the structure of the sheet is "open," it presents relatively little resistance to water vapor. This feature is important since it allows the wood to adjust to humidity changes without warping.

6. CreZon expands and contracts with humidity changes in a manner similar to wood, but at a different rate. This particular ratio of movement increases the dimensional stability of the wood surface. The contrasting densities of summerwood and springwood, and the resulting movement that can occur in wood faces from machining and moisture, causes early peeling and cracking of the paint film. CreZon's stabilizing effect on the surface sharply reduces the opportunity for this poor paint performance.

CREZON PRESSING SUGGESTIONS

I. VENEER

A. Smooth, pitch free, face veneer, B or better.
B. Core and back, C or better.
C. Veneer should be dried to between 3 - 6% moisture content.

II. GLUE

A. Any acceptable exterior phenol-formaldehyde glue mix should give satisfactory performance for veneers. The manufacturer's recommendation for spread and assembly time will be satisfactory for the overlay.

III. LAYUP

A. Blow off face veneer with air hose to remove small chips and particles. For 3-ply plywood lay CreZon face to face for speedier layup at spreader.
B. Be sure press is clean. If not using cauls, clean contamination off platens before pressing the CreZon.
C. Caution layup crew not to smudge or dirty the face of the CreZon. Handle with clean hands or gloves.

Optimum pressing conditions for B-210 CreZon Overlay with glueline are:

Temperature.....285^{o}- 290^{o} F.

Pressure.....190 - 200 PSI

Time.....Six minutes

Precure.....The time between loading the first sheet and closing the press shall not exceed two minutes.

(Typed verbatim from Crown Zellerbach Corporation release.)

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